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The Eskimos of the Northwest Passage:

A Survey of Dietary Composition and Various Blood and Metabolic Measurements

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ABSTRACT

In 1959 and 1960, during the annual survey conducted by the Federal Northern Health Services in the area of the Northwest Passage, the diet and living conditions of some 1500 Eskimos who live in this area were studied and blood and urine samples were obtained from 40-50% of this population. Hemoglobin, blood cell morphology, serum protein-bound iodine, serum proteins, serum lipids and serum total cholesterol estimations, urinalyses, and agglutination studies for brucellosis were carried out. Hemoglobin levels were in the normal range; however, increased contact with civilization appeared to be associated with lower hemoglobin levels. Eleven per cent of the Eskimos showed eosinophilia. Serum proteins were normal. Serum lipids and serum cholesterol levels were higher in Eskimo children living in a government residential school than in a comparable group living on the Barren Lands. Serum protein-bound iodine levels were in the upper euthyroid range. Diabetes mellitus occurs among Eskimos. Sporadic cases of brucellosis also occur.

SOMMAIRE

En 1959 et 1960, au cours du relevé annuel entrepris par les services d'Hygiène du gouvernement fédéral (territoires du N.O.), les enquêteurs ont étudié le régime alimentaire et le niveau de vie de quelque 1500 Esquimaux qui vivent dans cette région. Chez 40 à 50% des sujets, on a prélevé des échantillons de sang et d'urine. On a procédé aux analyses et épreuves suivantes: hémoglobine, morphologie des érythrocytes, iode lié aux protéines, recherches de la protéinémie, de la lipémie et de la cholestérinémie, analyses d'urine et séro-agglutination pour la brucellose. La quantité d'hémoglobine était dans les limites normales; il semble cependant qu'un contact plus intime avec la civilisation des blancs peut expliquer la diminution de l'hémoglobine. Dans 11% des cas, on trouvait une éosinophilie. La protéinémie était normale. La lipémie et la cholestérolémie étaient plus élevées chez des enfants pensionnaires de l'État qu'au sein d'un groupe d'enfants semblables vivant dans leur habitat naturel. L'iode lié aux protéines était situé dans la partie supérieure de la gamme euthyroïdienne. On trouve des cas de diabète sucré chez l'Esquimau et aussi des cas sporadiques de brucellose.

THE Eskimos living in the area of the Northwest Passage had been visited from the East and the West by explorers and searchers for the Franklin expedition in the eighteenth and nineteenth centuries and have only made permanent contact with white civilization since 1917. British

whaling ships had visited the Eastern Arctic between 1817 and 1913 and, at the end of the century, American whaling fleets were based on the Alaskan coast and at Herschel Island on the north-west Canadian coast. Trading posts had been established in the Mackenzie River delta at Fort McPherson in 1840, and in the nineteen twenties the Aklavik settlement had been opened with two small hos-

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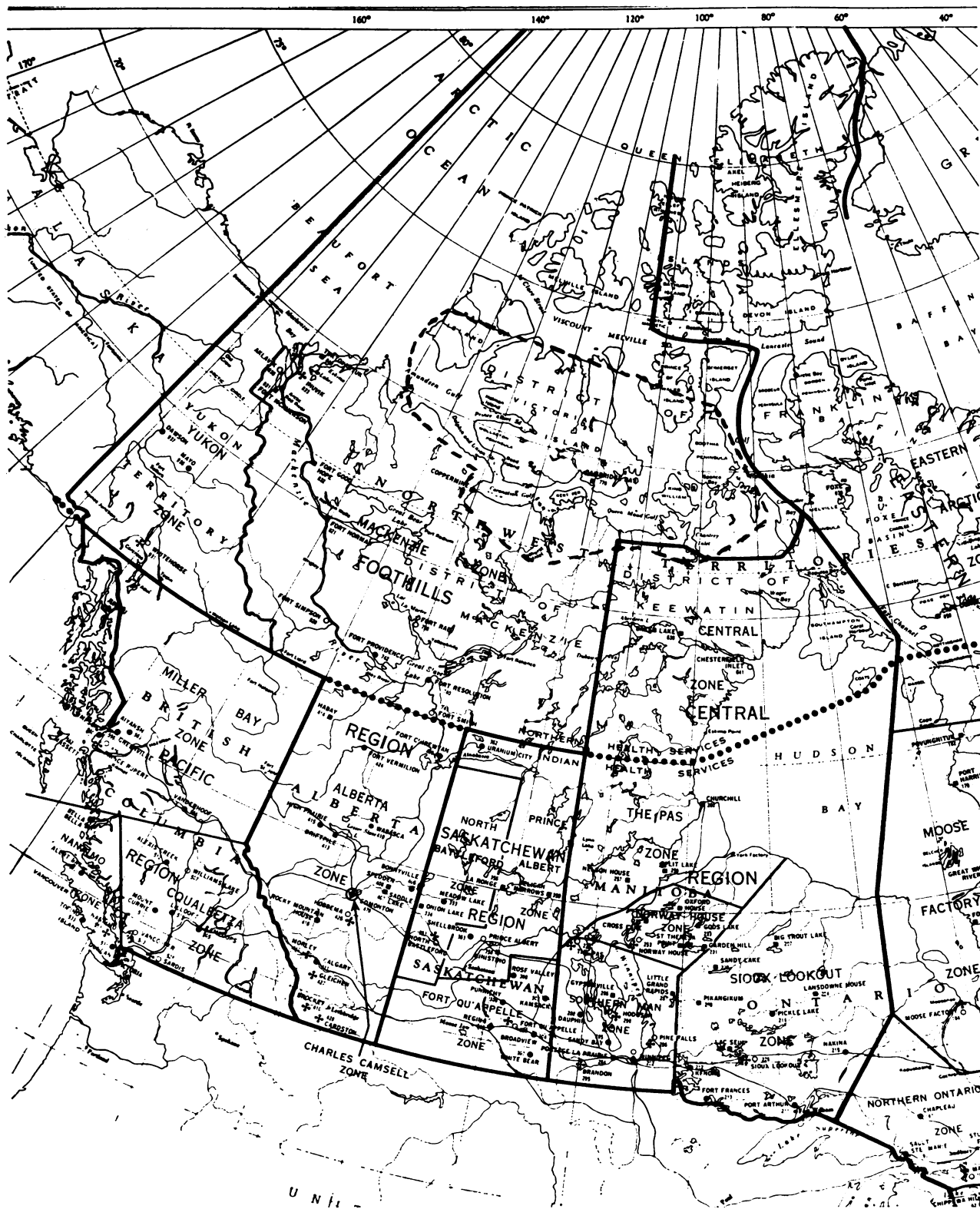


Fig. 1.—Canada.

- - - - - 1960 survey area.

..... Indian and Northern Health Services.

————— Regional and zone boundaries.

pitals and a resident medical officer. Early in the twentieth century, permanent medical officers were living in the Eastern and Western Arctic treating sick Eskimos. White man's epidemics had decimated local populations, full-blooded Eskimos had fought and died in France in the 1914-18 war and those

who returned encountered the 1919 Spanish flu epidemic which killed one-half the Eskimo population of Labrador.

Between the Eastern and Western Arctic lies the area of the Northwest Passage with its Eskimo inhabitants and its scattered trading posts which

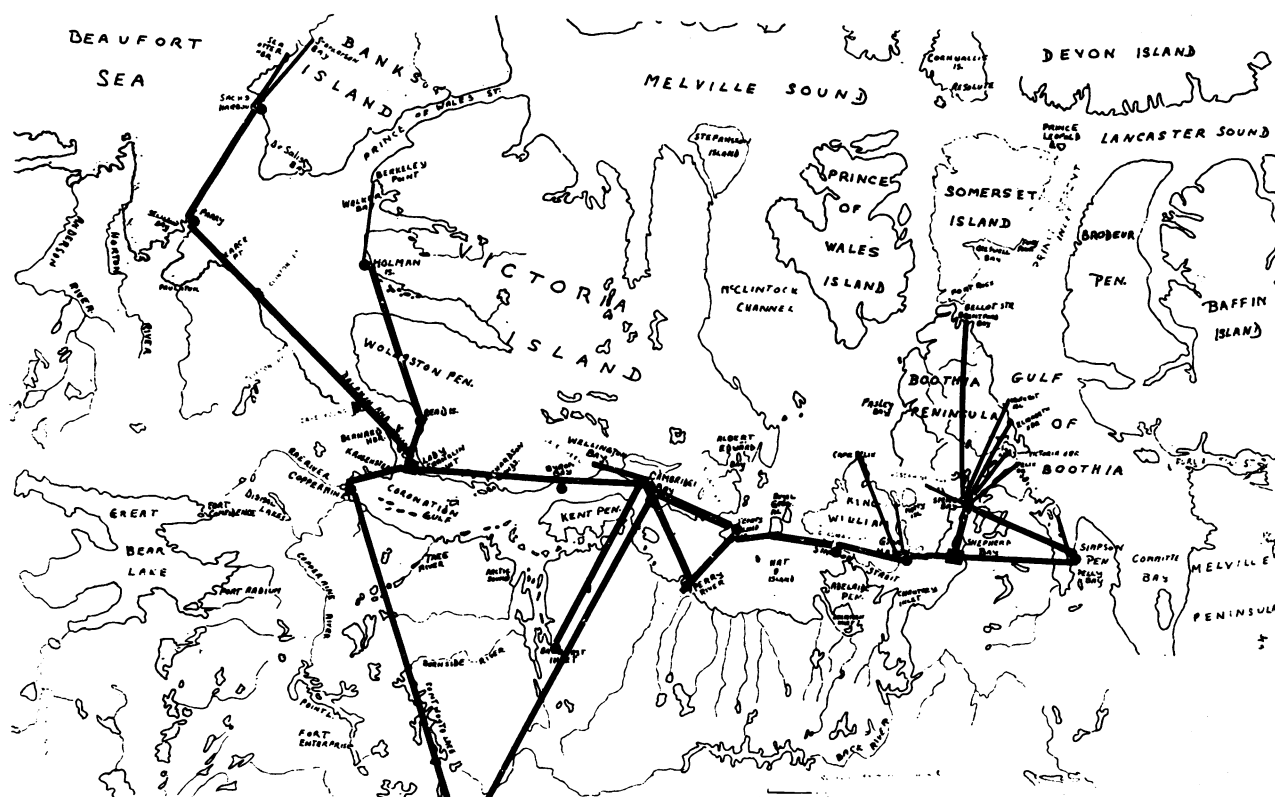


Fig. 2.—Northwest passage area of the survey. The duration of survey was 28 days; 1242 Eskimos were examined radiographically, 41 patients were evacuated, 13 because of active tuberculosis. The total distance flown was 12,803 miles. There were 18 x-ray centres. The developing centres are marked.

had been successively established, beginning with Bernard Harbour in 1917 to Spence Bay in 1948 (Figs. 1 and 2).

It was believed that further basic medical information might be obtained on this isolated group of Eskimos whose living, eating, educational and social habits were being rapidly changed by the new policies of the Department of Northern Affairs of the Canadian Government and the recent building of the Distant Early Warning (DEW) Radar Line.

The field work was done by the annual survey parties of Northern Health Services in 1959 and 1960 and a Federal-Provincial grant was obtained from the Department of Public Health of the Province of Alberta to complete the laboratory work on the specimens sent into the Camsell Hospital Laboratory in Edmonton.

THE ESKIMOS OF THE NORTHWEST PASSAGE AREA, 1959-1960

Eskimo Population

About 80% of this population is full-blooded Eskimo. In this century, some mixed marriages took place between Eskimos and whalers, early traders and visitors.

Area of the Survey (See Map*)

The 1500 Eskimos surveyed live in an area of 350,000 square miles bounded by Cape Parry (70°

10' North, 124° 40' West) and Storkerson Bay (73° North, 124° 30' West on the West), Pelly Bay (68° 32' North, 89° 50' West) and Fort Ross (72° North, 95° West on the East) and southward to Bathurst Inlet (66° 45' North, 108° West).

The terrain.—The mainland and the islands are mainly flat and treeless, broken by hundreds of small lakes which are barely discernible from the air in the winter. To find settlements and sealing camps under winter conditions requires excellent navigation.

Temperatures.—The maximum and minimum daily temperatures during the surveys were -5° F. to -41° F., with a daily average of -12° to -29°.

Inside temperatures.—These varied from 70° to 75° F. inside nursing stations and trading posts; cooler in missions and cold conditions in igloos heated by seal oil.

TABLE I.

	1961 census	Approximate population 1959 and 1960
Spence Bay area E. 4.	549	520
Cambridge Bay area W. 1.	477	450
Coppermine area W. 2.	485	460
Banks Island.		70
Cape Parry.		70
		1570
Less school children evacuated to Inuvik and patients in Camsell Hospital.		70
Available population.		1500

Windchill.—Temperatures when walking into the wind are approximately 1 degree lower per mile per hour of the wind.

Sources of income.—These include proceeds from the sale of fox fur, the occasional polar bear skin, and a few Eskimo carvings, old age pensions, family and welfare allowances, government salaries and DEW Line salaries. Additional income is sometimes obtained by Eskimo crews who have for many years been employed on small Arctic transport ships during the summer months.

ESKIMO LIVING CONDITIONS

Homes.—Over 70% of the Eskimos examined lived in igloos in the winter and tents in the summer. A few of these tents are made of caribou skin and the remainder purchased from trading posts. These are heated by seal-oil stoves and the warmth given off by the inhabitants. Ice or polythene (recently sold by the Hudson's Bay stores) windows are put in the igloo walls for daylight. Portable double-glazed windows in frames are also used by the better hunters living in big snow houses lined with tents or canvas. The other 25% live in shacks built from discarded packing cases, and a small percentage live in government-built homes for employees. The latter homes are heated with fuel-oil furnaces and some have electric light. In many other areas inhabited by Eskimos, driftwood is available for building, cooking and heating, but in the Northwest Passage area virtually none is available.

Water supply.—On the barren lands, water is obtained from melted ice and from water holes cut through the ice; in the settlements, from lakes and from iceblocks cut early in the winter and stored outside the homes. When travelling any distance over sea ice, small blocks of fresh-water ice are usually carried because salty new snow makes terrible tea, although it makes passable coffee and can be used for cooking.

Clothing.—Includes such items as double caribou skins and seal-skin mukluks (footwear), polar bear skins and caribou skins which are also used on the sleeping and sitting platform inside the igloos. There is an increasing use of white man's clothing (the numbers of caribou are diminishing): shirts, trousers, blankets, woollen underclothes, socks; and, in settlements, brassieres and cotton dresses of Eskimo fashion are purchased. Caribou skin, however, is light in weight and still remains the best protection against cold. Even in the settlement, Eskimo women usually wear it under their dresses.

Diet: Stores purchased from Hudson's Bay trading posts.—Ten to 30 per cent of the Eskimos live at or near trading posts, especially if they are pensioners, cripples or parents of school children. The remainder live at sealing or fishing camps and visit the trading posts twice yearly or more often,

depending on distance. Some have camps 100 to 200 miles away from a post and their only method of transportation is by dog team or occasionally by boat.

Ten to 25%¹ of their food is obtained from trading posts in exchange for furs, family allowances cheques, pensions and government salaries. The foods usually purchased consist of the following: flour, lard, baking powder, rolled oats, rice, biscuits, Pabulum, butter, dried milk, raisins, dried fruit, sugar, bacon, beans, jam, tea, salt and coffee. Biscuits and flour are the items purchased in the largest quantities; 200 lb. of flour for a family of four, and 4 lb. of baking powder to make bannock would be an annual supply. The same family would buy 20 lb. of tea and 5 lb. of coffee, both made very weak—e.g. 2 to 4 teaspoons to a gallon for tea and sufficient coffee to colour the water brown. A family living in a settlement will consume more store food, thereby diminishing their intake of native food.

At Pelly Bay² there is no trading post, the nearest being located at Spence Bay 110 miles north, but store food is brought in by Father Vandeveld by dog team from Repulse Bay. The settlement and local camps of 130 Eskimos purchase 650 lb. of tea, 150 lb. of coffee, 200 lb. of flour and rolled oats, and 200 lb. of baking powder. Sugar is too heavy to freight by dog team, and 500 bottles of saccharine are used as a substitute.

Salt.—Sinclair,³ presumably referring to Rink's Eskimo diet, states that no sodium chloride was added to the food. Stefansson⁴ states that Eskimos would not eat salted meat. Brown⁵ reports that small amounts of salt were taken with the food. Schaefer^{6, 20} states that Eskimos use $\frac{1}{4}$ part of sea water to $\frac{3}{4}$ parts of fresh water for cooking, and Dahl⁷ maintains that salt is obtained entirely from the meat eaten. Learmonth,¹ who lived in the Arctic or sub-Arctic regions of Canada for 45 years, agrees with Schaefer's statement on the addition of sea water for coastal Eskimos, but adds that as far back as 1923, the 140 local Eskimos of Bathurst Inlet purchased three dozen 2-lb. packets of salt annually for cooking purposes, and the purchases of salt can be ascertained from the Hudson's Bay expenditure accounts at local northern stores. Learmonth¹ also adds that Eskimos, for centuries, have been obtaining salt from licks, such as that on the north shore of Schwatka Bay on King William Land.

NATIVE DIET BY SEASONS¹

April to Mid-June.—Meat and fish caches are almost empty. Seals basking in the sun are being hunted on the ice instead of being hunted through the *aglo* (seal hole), and all fat surplus to daily requirement for light, heating and cooking is put into seal-skin pokes and cached for further use. Any surplus meat is cut into strips, dried in the sun and cached. There are a number of eider

ducks feeding on sea lice (type of shrimp) along the tide cracks in the ice.

Mid-June through July.—As the dissolving ice recedes and the leads in the ice pack open, arctic char which appear in the open water are speared or netted, then split and dried in the sun, the entrails being fed to the dogs. Surpluses are cached. Only a few seals are killed, as they are not in good condition; their hair is sloughing and they have only a fibrous, oily layer instead of the usual rich blanket of fat. Before the sea ice becomes too rotten for travel, the hunters go to the mainland searching for deer, while the others remain in fishing camps where trout is abundant and ducks, geese and loons are plentiful.

August through September.—Caribou obtained at this season provides the best clothing and skins for sleeping platforms. Surplus meat is either cached whole or cut in strips, dried in the sun and cached. Surplus back fat (suet) in the natural state and the fat around the intestines are rendered down and put into pokes and cached. The older folk and the others living around the fishing camp spear trout and hunt birds or anything edible—e.g. ground squirrels (mainland only) and arctic hares. In late August and early September most of the Eskimos are on the river banks or at the mouths of rivers where arctic char collect off shore and start moving upstream to their spawning grounds where great numbers are netted, speared or caught in river rock traps (weirs). Thousands of prime, fat char are always cached whole at this time and a few are split and dried. Young fat eider ducks and ptarmigan are plentiful and easy to obtain at this time.

October through November.—People now live on caches, but also hunt seals which are becoming prime and fat again. Hare, ptarmigan and often caribou are also available. In mid-November fox trapping has usually started locally in the vicinity of camps, and ambitious trappers will have moved farther away. Young fat foxes are sometimes eaten, although usually the carcasses are fed to the dogs.

December through March.—People live at sealing camps in their winter quarters, where *aglo* hunting for seals is the main standby because the seals are now blanketed with large quantities of fat and are at their best. Most of the fat obtained is used for heat, light and cooking purposes in the igloos. In March they jig through holes in the sea ice for tom cod whose roe and liver are more prized than the flesh. After the cod have spawned, they are left strictly alone until March of the following year.

Variations of diet.—In *Bathurst Inlet and Perry River*,⁸ 60% of the food is eaten raw, 30% is cooked (boiled) and 10% is white man's food. Fish is the main basic food, which is usually eaten raw—frozen, dried or fresh, but the heads are usually boiled and the skin is always eaten as a delicacy. Seals are found in the Perry River area, but there are only a few at Bathurst, and the meat

is boiled except for the livers, which are eaten raw and fresh. Birds, squirrels and foxes are always eaten boiled. Polar bears are rarely found in this area. Caribou meat is available on an irregular basis and is eaten raw (frozen), boiled or dried, and the caribou back fat which has been cached is served with lean food. Birds' eggs are eaten when available, but no shell fish are taken.

In the *Holman Island*⁹ area, food is usually eaten raw and when cooked is either boiled or stewed. Caribou and seal meat is eaten complete with kidneys, liver (fresh), brains, eyes, small intestines and the stomach cud (fresh). Polar bear meat is available and is always cooked. The Eskimo has learned by experience to avoid eating the liver of polar bears which produces an illness presumed to be due to its very high vitamin A content. Large quantities of sea-gull and duck eggs are eaten fresh, but are never stored. Ducks shot in large numbers are stored by freezing; these are plucked, boiled and eaten with the skin in the summer, but are skinned in the winter as the underlying fat imparts an unpleasant flavour to the meat. Whales, walrus and porpoise are rarely found either here or in the Northwest Passage area because the sea freezes solid and open water is necessary for their survival. Plenty of shell fish are available, but these are never eaten, nor is the available seaweed used as food. In the short summer, mountain sorrel and berries are eaten raw or cooked.

In the *Pelly Bay*² area the majority of food is eaten raw—it is the exception to cook meat apart from that of the polar bear. Fish are eaten completely and even the bones are chewed which give a tasteful sap. Foxes are never eaten, and only a few birds such as ptarmigan are available.

In the *Read Island*¹⁰ area the staple diet is fish, usually eaten raw (frozen) with an average daily consumption of about 2 lb. Caribou and seal meat is also available and in the two summer months, ducks, geese and ptarmigan. Though there are clam beds, none of the Eskimos eat shell fish, nor do they eat dulse (seaweed).

There are in addition variations in the quantities of the food available. In the past there have been periods of starvation which are now becoming rare with the increasing supervision by the Canadian Government and the availability of aircraft.

The diet of the Northwest Passage Eskimo has been changing rapidly from the native diet described by Hanbury¹¹ (1902), Amundsen¹² (1903-1906), Stefansson¹³ (1908-1918), Jenness¹⁴ (1913-1916), Rasmussen¹⁵ (1927) and Learmonth¹ (1917-1957) to a mixed diet of native and white man's food. This mixed diet does not appear to be as adequate as a full native diet for the Eskimo's nutrition. Sinclair³ in 1953 discussed the changing dietary habits of the Eskimos and warned governments of the possibility of malnutrition during the transition of eating habits.

Survey conditions (1959-1960).—Superintendent Henry Larsen, R.C.M.P., successfully sailed the vessel *St. Roch* with a small R.C.M.P. crew through the Northwest Passage west-east and east-west between 1942 and 1944. Five years later Dr. John Callaghan¹⁶ of Indian Health Services made the first x-ray survey of the area by Norseman aircraft. Subsequent surveys were made in 1951 by boat and air and from 1953 to 1960 annually by air. All surveys up to 1955 had been essentially for radiologic work to find tuberculosis, and medical examinations were only made on those who requested medical advice. From 1956 to 1960 physical examinations were made on all Eskimos attending the survey.

Experience has proved that successful survey work in this area has to be done by air in the months of March and April, when the days are long and the weather is good. This time of the year also suits the Eskimos, who come into the settlements with their families to exchange their fox furs for store food and clothing. Their stay is short owing to the problem of obtaining native food for themselves and their dogs. Some families remain at their sealing camps, and to ensure their attendance the survey party's Otter aircraft is sent out to collect them. They are brought into the settlement, examined and returned to their camps immediately afterwards. In 1960, 236 Eskimos were brought in and returned by this "taxi" service.

The single-engined de Havilland Otter is to date the best aircraft for survey work and with wheel/ski gear can land on gravel airstrips at radar sites or on ice strips at settlements and sealing camps. The aircraft load is limited to 2000 lb. and with a party of two medical officers, a dental officer, two x-ray technicians, medical and dental equipment, any additional poundage has to be minimal.

Therefore, we decided that any additional field work would have to be done by the routine survey party and any extra equipment would have to be small, light and easily carried, as the party, clothed in bulky Arctic survival kit, have to handle their own equipment in temperatures often below -30°C ., using dog teams and sleds for transportation after landing.

The working conditions varied. Specimens were obtained under ideal conditions at the nursing stations at Cambridge Bay and Coppermine, less convenient conditions in kitchens and bedrooms at Spence Bay, Perry River, Bathurst Inlet, Read Island and Holman Island, and decidedly rough conditions in winterized tents near radar sites and in an igloo clinic at Pelly Bay.

Urine specimens, obtained in disposable drinking cups, had to be examined quickly because the majority of centres had outside toilets and samples froze in a few minutes.

Blood samples, taken by vacutubes (Becton, Dickinson & Co.), had to be flown to the nearest

radar site or nursing station where 110 AC current was available to operate an electric centrifuge. The separated sera were immediately frozen and later flown to the Camsell Hospital Laboratory. Blood smears were taken and later stained and examined in the same laboratory. Hemoglobin estimations were done at the time of examination, using the Spencer hemoglobinometer.

Large wide-mouthed thermos containers were used for carrying immunization material and bloods as a precaution against the failure of the aircraft heating system.

The estimated survey time of four weeks in which to travel 12,000 miles and do routine examinations considerably limited the amount of extra field work that could be undertaken. It was, however, possible to obtain a large number of samples of blood and urine from Eskimos living under winter conditions who had consumed a fixed pattern of diet during the previous three months.

The urine and hemoglobin specimens were examined in the field by the authors and Mr. Walter Price of the Camsell Hospital Laboratory. The sera and slides were obtained at the same time and later flown to the Camsell Hospital Laboratory.

In February 1961, a Federal grant was obtained through the Department of Public Health of the Province of Alberta to purchase laboratory equipment and to complete the examination of the sera. The laboratory work was done by Mr. Walter Price under the supervision of one of the authors (S.H.) in the Camsell Hospital Laboratory.

RESULTS

Hemoglobin (Fig. 3).—Blood hemoglobin levels were measured with a Spencer hemoglobinometer which was calibrated against a spectrophotometer using a Department of National Health and Welfare standard. It was determined to be accurate to within $\pm 0.5\text{ g. \%}$.

Six hundred and twenty-four blood specimens of Eskimos between one and 78 years were examined. Omitting the 1 to 5 year age group, the mean for 346 males from six to 78 years was 14.5 g. %, one standard deviation was $\pm 1.3\text{ g. \%}$ and the range 10.5-16.6 g. %. For 266 females the mean was 13.2 g. %, one standard deviation $\pm 1.1\text{ g. \%}$, and the range 8.0-16.0 g. %. Both means lie within the normal range of 13-16 g. % for men¹⁷ and 12-14 g. % for women.¹⁷

Of 624 specimens, 40 men (12% of the males) had levels below 13 g. % and 19 women (7% of the females) below 12 g. %. Five were below 10 g. %.

It was noted that of 142 specimens, 17% of the men and 13% of the women of Cambridge Bay had levels below 13.0 g. % and 12.0 g. %, respectively.

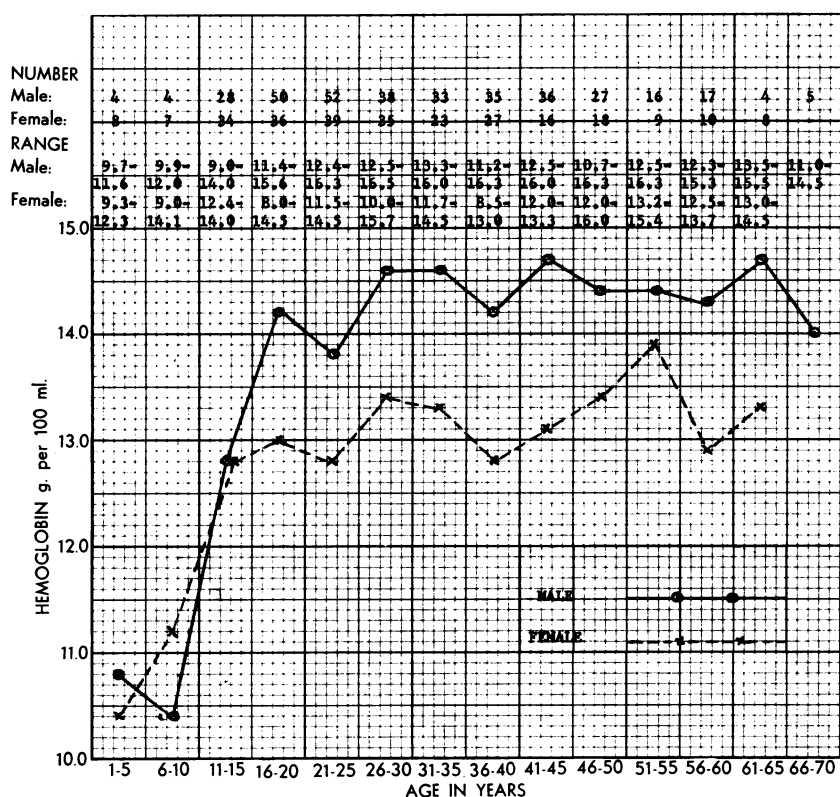


Fig. 3.—619 Eskimo hemoglobin estimations: means for males and females by age groups.

In this settlement, a number of Eskimos have recently made permanent homes, are adopting white man's habits and have increased opportunity of exposure to infection. In contrast, no levels below 13.0 g. % and 12.0 g. % were found in the population of 39 at Bathurst Inlet, and only 4.4% of the Boothia Peninsula population of 135 were below normal. Both of these areas are isolated and the native diet predominates.

Rabinowitch¹⁸ expressed the opinion that the Eskimos of Northeast Canada were plethoric in appearance, were polycythemic and had excessive hemoglobin (Hb) levels.

Brown⁵ gives average Hb levels on Southampton Island Eskimos late in the summer as 13.3 g. % for men and 12.7 g. % for women. Sellers, Wood and Hildes¹⁹ examined 331 children and 344 adult

Eskimos during August 1957 and 1958 and showed that anemia was common among Eskimo infants and young children, while two of the same authors found normal Hb levels in adult Eskimos of the Central and Eastern Arctic areas. Schaefer²⁰ gives Hb levels for adult Eskimos of Aklavik and Pangnirtung as 15-16 g. % for males and 14-15 g. % for females and children, at or above normal values for age groups. Pett and Ogilvie²¹ reported on 3148 Hb levels in age groups in persons between 1 and 79 years, giving an average of 13.5 g. % for males and 12.7 g. % for females living in Canadian provinces.

Of 624 Eskimos studied, 90% had a normal Hb level and 10% a level below normal. Increasing contact with white man's living conditions may be resulting in the development of below-normal Hb levels in some Eskimos, caused by inadequate nutrition.

Blood Film Examinations, March and April, 1959 and 1960 (Table II)

Seven hundred and twenty-five blood films were made from blood taken from the antecubital veins of Eskimos (408 male and 317 female) between the ages of six and 78 years. The blood smears were stained by Wright's method. Platelets were plentiful on smear examinations in every instance.

Eosinophilia.—Total white cell counts were not done. Eighty slides (11%) of the smears examined showed more than 5% eosinophils. Many of the cases examined had had skin tests for trichinosis and hydatid disease in 1957 and 1958, and 144 Eskimos had positive tests for trichinosis and 115 positive Casoni tests for hydatid disease.²² Brown *et al.*²³ found that 40% of 265 people on Southampton Island gave positive reactions for

TABLE II.—RESULTS OF BLOOD FILMS TAKEN IN DIFFERENT ESKIMO SETTLEMENTS

Place	Normal film	Neutrophilia	Hypochromia of RBC	Over 4% eosinophils	Lymphocytosis	Atypical lymphocytes	Monocytosis	Total
Cambridge Bay.....	125	17	3	17	9	9	—	180
Spence Bay.....	94	7	1	21	8	4	—	135
Coppermine.....	77	9	1	9	13	0	—	109
Bathurst Inlet.....	17	8	1	4	12	—	—	42
Holman Island.....	26	7	—	2	9	—	—	44
Read Island.....	13	1	—	1	1	—	—	16
Pelly Bay.....	16	4	—	7	6	—	1	34
Near radar sites.....	43	10	—	15	7	—	—	75
Perry River.....	20	6	—	3	7	1	—	62
Totals.....	476	71	6	80	77	14	1	725

NOTE:—Neutrophilia and lymphocytosis were estimated on the basis of observation of the number of leukocytes in the blood film coupled with a differential count.

trichinosis, and Thorborg, Tulinius and Roth²⁴ have reported outbreaks in Greenland. Coffey and Wiglesworth²⁵ diagnosed the first Canadian case brought to autopsy in 1956. Hydatid disease among Eskimos in this area was discovered during radiologic surveys between 1949 and 1960 and discussed by Meltzer *et al.*²⁶

Fish forms a large part of the native diet, and tapeworms of the genus *Diphyllobothrium*²⁷ are present in the fish of this region. Several Eskimos admitted to the Camsell Hospital²⁸ for other diseases have also been found to be suffering from fish tapeworm infestations.

The Eskimos of the Barren Lands have no wood available for cooking purposes: they never fry food, and if cooked, it is always boiled or stewed and often eaten raw (frozen) or fresh, although polar bear meat is almost always cooked. The prevention of the spread of trichinosis, hydatid disease and worm infestation is and will be for some years a difficult problem for the Barren Lands Eskimos.

protein with impregnated strips (Uristix) (Table III). Twenty-four specimens gave a positive test for glucose. Two specimens gave a positive test for protein. Physical, radiographic and blood studies on the 26 individuals from whom these urines were obtained revealed no abnormality.

Rabinowitch and Smith²⁹ on an Eastern Arctic patrol in 1935 examined 75 Eskimo urines and three of these showed reducing substances. Scott and Griffith³⁰ made blood sugar studies on 1227 Alaskan Eskimos and only *one* instance of elevated blood sugar was found in a pure-blooded Eskimo. They also noted that only three diabetics had been found in 16,000 Eskimos. Schaefer^{6, 20} and Urquhart³¹ did not find a single case of diabetes in four years of northern service. In contrast, Kenny, Chute and Best³² found that 1.2% of the 4419 population of Newmarket, Ontario, suffered from diabetes.

Diabetes was discovered in two Eskimo patients out of the 1500 Eskimos of the area surveyed. One was an Eskimo woman aged 54 and the other an

TABLE III.—URINE EXAMINATIONS, 1959 AND 1960 (MARCH AND APRIL)

Place	Age in years	Male	Female	Total	Normal urine	Positive glucose	Positive protein
Cambridge Bay.....	6 - 71	90	75	165	147	17	1
Spence Bay.....	6 - 78	69	54	123	120	3	—
Pelly Bay.....	5 - 74	21	18	39	39	—	—
Gjoa Haven.....	11 - 65	29	19	48	48	—	—
Perry River.....	16 - 60	17	3	20	18	2	—
Bathurst.....	13 - 60	24	15	39	39	—	—
Coppermine.....	3 - 71	15	17	32	30	2	—
Holman Island.....	1 - 69	27	11	38	37	—	—
Read Island.....	4 - 59	7	6	13	13	—	1
Eskimos near radar sites on white man's diet	7 - 58	46	12	58	58	—	—
In residential schools and hospitals.....	5 - 55	26	36	62	62	—	—
Totals.....		371	266	637	611	24	2

Neutrophilia.—Seventy-one of the blood films examined showed neutrophilia. At the time of the survey, many of the Eskimos had upper respiratory infection and, radiologically, 33 cases of pneumonic infection were noted at Coppermine and 23 cases at Cambridge Bay. Chronic otitis media was common and many chest films showed heavy basal markings.

Hypochromia of erythrocytes.—Six slides showed hypochromia of red cells. Two of these were taken from patients who were diagnosed as having acute trichinosis and were evacuated to the Camsell Hospital. The other four were clinically asymptomatic.

Lymphocytosis.—Seventy-seven slides showed a mild relative lymphocytosis. Of the 725 patients examined, 269 had previously suffered from chest, bone, glandular and renal tuberculosis; others had chronic coughs and many had chronic otitis media.

In summary, 725 blood films were examined. Eleven per cent of the smears showed eosinophilia, which may be accounted for by the high incidence of trichinosis, and hydatid and fish tapeworm infection.

Urine Examinations

Urine studies have never been made in previous medical surveys. Urines were tested for glucose and

Eskimo man aged 41, both diagnosed in the Camsell Hospital.²⁹ These cases gave definite biochemical evidence of diabetes while on long-term adequate carbohydrate and protein diet. A third possible case in a patient who died of carcinoma was excluded.

To summarize, diabetes occurs among Eskimos. Routine urine testing and blood glucose studies would probably find other, hitherto unsuspected cases. It is possible that prior to the spread of white civilization and the extension of medical services, some diabetic women died and naturally eliminated the spread of the hereditary factors. It is also possible that the changing diet may play a role.

Brucellosis

Seven hundred and eighty-seven microscopic slide agglutination tests for brucellosis were performed on thawed serum samples six to nine months after collection. A 26-year-old woman at Cambridge Bay and an 18-year-old woman at Coppermine showed agglutinations of 1:10+.

Greenberg, Blake and Gorman³³ found one serum with a titre of 1:10+ from Bathurst Inlet among 232 sera examined in an immunological study of the Canadian Eskimo in 1955. Seven cases

of brucellosis³⁴⁻³⁷ have previously been reported in Eskimos, five from Bathurst Inlet, one from Cambridge Bay and one from Coppermine. In four of these cases the organism was isolated, and the remaining three were diagnosed by agglutination tests. In regard to this disease, an epidemiological link has recently been established by Huntley³⁸ between the caribou and human beings.

In summary, sporadic cases of brucellosis, most commonly found at Bathurst Inlet, occur in the caribou eaters of this area. It is probably associated with poor cooking facilities.

Serum Protein-Bound Iodine Levels (PBI)

Serum PBI levels have not been previously reported on a large group of Canadian Eskimos. In this study 726 samples of sera were taken from Eskimos living under winter conditions and whose main food was fish and seal meat. Serum PBI levels were determined by an acid distillation procedure.^{39, 40} Versatol was used as a control serum, the acceptable limits of control being $\pm 3\%$ of the stated assay. The normal euthyroid PBI range in the Charles Camsell Laboratory where these determinations were made is 4.0-8.0 $\mu\text{g. \%}$. Of the Eskimo women in this series, 11% were pregnant and had a mean PBI level of 7.2 $\mu\text{g. \%}$.

Gottschalk and Riggs⁴¹ reported PBI levels on seven American soldiers at Fort Knox and at Churchill in Canada under winter conditions. PBI levels did not rise under winter conditions and remained in the range of 3.5-7.0 $\mu\text{g. \%}$. At the same time, he determined PBI levels on 17 Eskimos living under summer conditions. Ten pure-blooded Eskimos from Southampton Island averaged 7.1 $\mu\text{g. \%}$ and three from Chesterfield 5.8 $\mu\text{g. \%}$. Two half-breed Eskimo/Indians averaged 6.3 $\mu\text{g. \%}$ and two half-breed Eskimo/whites 5.0 $\mu\text{g. \%}$. Rodahl and Bang⁴² studied thyroid function in man under cold conditions in Alaska. PBI levels were determined for groups of whites, Indians and Eskimos. PBI levels for all Eskimos under summer and winter conditions had a mean of 6.1 $\mu\text{g. \%}$, whites 5.5 $\mu\text{g. \%}$ and Indians 5.5 $\mu\text{g. \%}$. Mean fasting serum cholesterol levels in the same groups were as follows: Eskimos 215 mg. per 100 ml., whites 198 mg. per 100 ml., and Indians 212 mg. per 100 ml. Rodahl and Bang believe that PBI and cholesterol levels remain the same regardless of season.

Osiba⁴³ studied basal metabolic rates and PBI levels of a small group of Japanese living under normal conditions. Japanese homes are poorly insulated, and patients were tested monthly under summer and winter conditions. Mean serum PBI levels were 7.9 $\mu\text{g. \%}$ in winter and 4.7 $\mu\text{g. \%}$ in summer.

Only one instance of thyroid enlargement was seen in an Eskimo during the 1959 and 1960 surveys, and only one Eskimo with thyrotoxicosis

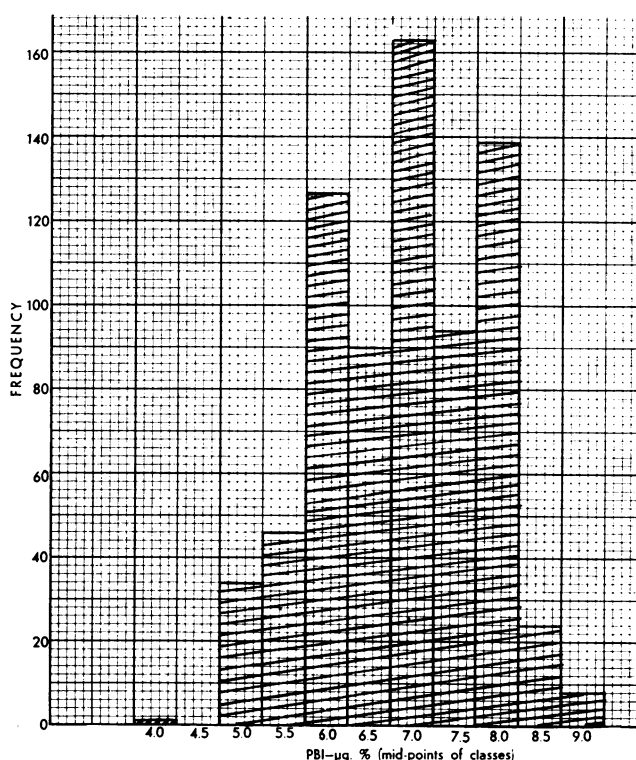


Fig. 4.—PBI levels of 726 Western Arctic Eskimos. Sera taken in March and April, 1959 and 1960.

has been admitted to the Camsell Hospital²⁹ in the past 10 years from the same area. This patient was admitted in 1958 and had previously been in hospital under PAS and INH treatment for tuberculosis.

In this series of 726 Eskimos, serum PBI levels taken under winter conditions showed a mean level of 6.9 $\mu\text{g. \%}$. One standard deviation was ± 0.9 $\mu\text{g. \%}$ and the range was 4.0-8.9 $\mu\text{g. \%}$. PBI levels were determined on a group of 40 children (5-16 years) at Inuvik School in December 1959; these children had been living in warm hostels and on white man's diet. Their mean serum PBI level was 6.6 $\mu\text{g. \%}$, one standard deviation ± 0.8 $\mu\text{g. \%}$ and the range 5.0-8.1 $\mu\text{g. \%}$.

In summary, the serum PBI levels on 726 specimens from Eskimos living in native conditions, under winter conditions, gave a mean of 6.9 $\mu\text{g. \%}$, which is high in the euthyroid range (Fig. 4).

Serum Protein Levels

Serum protein levels were determined on 408 non-fasting male and 319 female Eskimos between the ages of one and 78 years living on a mixed diet of native and store food (Table IV). Serum protein levels were also determined on a group of Eskimo school children, 5 to 16 years, from the same area, who had been living on white man's diet for three months at the residential school at Inuvik (Table V). In neither group was there a significant difference between the values obtained for males and for females.

TABLE IV.—SERUM PROTEINS (g. per 100 ml.): 727 ESKIMOS LIVING UNDER NATIVE CONDITIONS

	Mean	1 standard deviation	Range
Total protein.....	6.8	±0.52	5.2-8.2
Albumin.....	4.2	±0.48	3.1-5.2
Globulin—alpha-1.....	0.2	±0.05	0.1-1.0
alpha-2.....	0.7	±0.11	0.2-1.1
beta.....	0.7	±0.11	0.2-1.1
gamma.....	1.0	±0.28	0.5-2.7

Total protein was estimated by the biuret method.⁴⁴ Albumin and globulin fractions were estimated by paper electrophoresis⁴⁵ followed by elution and determination of the protein content of the various fractions by the biuret method. Versatol (General Diagnostics Division, Warner-Chilcott) was used as a control serum with the requirement that the result obtained for it be within $\pm 3\%$ of the assay value as determined by the manufacturer.

TABLE V.—SERUM PROTEINS (g. per 100 ml.): 40 SCHOOL CHILDREN LIVING IN INUVIK HOSTELS

	Mean	1 standard deviation	Range
Total protein.....	7.1	±0.36	6.1-7.8
Albumin.....	4.2	±0.46	3.2-5.0
Globulin—alpha-1.....	0.3	±0.05	0.2-0.4
alpha-2.....	0.7	±0.11	0.5-1.0
beta.....	0.7	±0.14	0.5-1.0
gamma.....	1.2	±0.40	0.6-2.1

Corcoran and Rabinowitch⁴⁶ estimated total serum protein values on 27 Eskimos, some of whom subsisted on a diet of native and store food and some on a native diet. All protein values were within the range of 6.4-8.0 g. per 100 ml., with an average of 7.0-7.2 g. %.

TABLE VI.—SERUM LIPIDS (mg. per 100 ml.)

	408 males			319 females			Total		
	Mean	1 S.D.*	Range	Mean	1 S.D.	Range	Mean	1 S.D.	Range
Total lipids.....	552	±66	380-695	559	±67	408-701	555	±66	380-701
Lipid phosphorus.....	9.0	±1.2	6.8-11.9	8.9	±1.3	6.2-11.7	8.9	±1.2	6.2-11.9
Total cholesterol.....	182	±24	139-300	183	±23	138-280	183	±24	138-300

*S.D. = standard deviation.

Brown *et al.*⁵ estimated total plasma protein at 7.57 (± 0.58 SD) by the Kjeldahl method and plasma albumin at 3.98 (± 0.67 SD) by the sodium sulfate method.

Krogh and Krogh⁴⁷ estimated that the daily intake of protein for Eskimos was approximately 282 g.,

Rabinowitch¹⁸ 250-300 g., Hygaard⁴⁸ 299 g. and Brown *et al.*²³ 103 g. Rodahl⁴⁹ gave a mean of 148 g. for Alaskan Eskimos under winter and summer conditions and compared the Eskimo requirement of 148 g. on native and store diet with 92 g. for Alaskan airmen and 109 g. for infantry in Alaska.

In summary, non-fasting serum protein levels were estimated in 727 Eskimos living on a native and store diet. Similar estimations were also made on a small group of Eskimo school children on white man's diet in a residential school. The serum protein levels of this group of Eskimos living on a native and store diet remained within normal limits.⁵⁰ The serum protein levels of the school children were also found to be within normal limits.

Serum Lipids

Total lipids, lipid phosphorus and total cholesterol determinations were performed on sera of 408 male and 319 female Eskimos between the ages of one and 78 years who were living on a mixed diet of native and store food (Table VI).

In addition, the total lipids, lipid phosphorus and total cholesterol were determined on sera of 40 Eskimo school children between the ages of 5 and 16 years (Table VII). Three months earlier, these children had been flown from the Northwest Passage area into Inuvik, where they had been living at the residential school and had been eating a normal school diet supervised by a government dietitian. A similar age group of Eskimo children living on the Barren Lands and eating native and store food was studied for comparison (Table VIII).

Using the 't' test to compare the mean values found for males and females in each of the three groups (Tables VI, VII, VIII), no significant difference was found between the values obtained for males and females for total lipids, lipid phosphorus or cholesterol ($p > 0.10$). Similarly, the

TABLE VII.—SERUM LIPIDS OF 40 SCHOOL CHILDREN 5-16 YEARS OF AGE LIVING ON SCHOOL DIET AND HAVING LIMITED ACTIVITY (mg. per 100 ml.)

	17 boys			23 girls			Total		
	Mean	1 S.D.*	Range	Mean	1 S.D.	Range	Mean	1 S.D.	Range
Total lipids.....	596	±45	520-661	609	±43	500-682	604	±44	500-682
Lipid phosphorus.....	9.2	±1.2	7.4-11.9	9.2	±1.2	7.0-11.9	9.2	±1.2	7.0-11.9
Total cholesterol.....	203	±15	179-225	203	±18	169-236	203	±17	169-236

*S.D. = standard deviation.

TABLE VIII.—SERUM LIPIDS OF CHILDREN ONE TO 16 YEARS OF AGE LIVING IN N.W. PASSAGE AREA AND EATING NATIVE AND STORE FOOD WITH FULL ACTIVITY (mg. per 100 ml.)

	67 boys			59 girls			Total		
	Mean	1 S.D.*	Range	Mean	1 S.D.	Range	Mean	1 S.D.	Range
Total lipids.....	540	±64	415-662	555	±72	410-695	547	±68	410-695
Lipid phosphorus.....	8.7	±1.1	6.9-11.5	8.8	±1.1	6.5-11.7	8.7	±1.1	6.5-11.7
Total cholesterol.....	174	±20	145-240	178	±24	140-255	176	±22	140-255

*S.D. = standard deviation.

means obtained for children at school in Inuvik were compared with those obtained for children living on the Barren Lands. The mean total lipid values of the school children (boys, girls and total) are significantly higher ($p < 0.001$) than those of the other group. While there is no significant difference between lipid phosphorus levels of the boys of the two groups, or of the girls ($p > 0.10$), a comparison of the total means for each group shows that the lipid phosphorus level of the school children is significantly higher ($0.05 p < 0.02$). Total cholesterol levels (boys, girls and total) are also significantly higher ($p < 0.001$) in the school children.

Serum Cholesterol by Age Groups

The life expectancy of the Eskimo is about 32 years.⁵¹ In consequence, the majority of sera tested came from 11-50 year age groups. Table IX shows serum cholesterol levels according to various age groups. Again applying the 't' test, no significant difference was found in the cholesterol levels between males and females within any one age group.

TABLE IX.—SERUM CHOLESTEROL VALUES BY AGE GROUPS (mg. per 100 ml.)

Age group (years)	Males				Females				Total			
	No.	Mean	1 S.D.*	Range	No.	Mean	1 S.D.	Range	No.	Mean	1 S.D.	Range
1 - 10	17	569	±18	145-210	8	168	±14	152-192	25	169	±17	145-210
11 - 20	91	178	±24	145-255	84	181	±24	140-255	175	179	±24	140-255
21 - 30	97	182	±25	140-280	86	183	±23	138-255	183	183	±24	138-280
31 - 40	77	183	±25	145-300	59	184	±27	150-280	136	183	±25	145-300
41 - 50	76	185	±21	145-225	44	189	±23	148-260	120	187	±22	145-260
51 - 60	37	189	±26	139-250	22	182	±21	140-215	59	186	±24	139-250
61 - 80	13	190	±29	150-260	16	190	±25	150-225	29	190	±26	150-260

*S.D. = standard deviation.

Total serum lipid estimations were made by the method of Brandstein and Castellano.⁵² As no commercial control serum was available, a normal serum was run and all determinations were made in duplicate and accepted only if they agreed within 3%. Serum lipid phosphorus was determined by the method of Youngburg⁵³ and total serum cholesterol levels by a modified Pearson, Stern and McGavack⁵⁴ method. For these estimations, Versatol was used as a control and acceptable results were those that were within $\pm 3\%$ of the assay. For the method used, the normal range of cholesterol levels for adults is 150-250 mg. %.

In Canada, Brown⁵ estimated the plasma lipids on non-fasting sera of 61 Eastern Arctic Eskimos and obtained levels of 520 (S.D. ± 118) for total

lipids, 9.88 (S.D. ± 1.98) for phospholipids and 173 (S.D. ± 29) mg. per 100 ml. for total cholesterol. Corcoran and Rabinowitch⁴⁶ (using Boyd's modification of Bloor and Yasyda's method) estimated blood lipids on non-fasting sera of 27 Eskimos taken during summer months and concluded that the mean total lipid was 555 mg. per 100 ml. and the mean total cholesterol was 141 mg. per 100 ml. Pett and Lupien⁵⁵ studied the serum cholesterol levels of 124 Eastern Arctic Eskimos between the ages of 15 and 50 years and over and found a mean of 201 mg. per 100 ml. for men and 207.5 per 100 ml. for women.

In Alaska, Wilber and Levine⁵⁶ estimated lipid levels on 70 Eskimos and found that the mean fatty acid was 746 mg. for men and 712 mg. per 100 ml. for women; lipid phosphorus was 14.9 mg. for men and 15.8 mg. per 100 ml. for women, and serum cholesterol was 203 mg. for men and 233 per 100 ml. for women. Rodahl⁵⁷ found that the fasting serum cholesterol level for all seasons in 76 Eskimos was 215 mg. per 100 ml. Scott *et al.*⁵⁸ estimated non-fasting cholesterol levels (method

of Abell *et al.*) of Alaskan male Eskimos between the ages of 17 and 53 years and, although there was considerable variation in the means of the inhabitants of 43 villages, found an over-all mean of 214 mg. per 100 ml. (S.D. ± 40.9) for the 842 male Eskimos.

According to Scott *et al.*,⁵⁸ the majority of today's Alaskan Eskimos do not consume a high fat diet. Learmonth¹ after 42 years of Arctic experience is of the same opinion.

In summary, the total lipids, lipid phosphorus and total cholesterol levels of 727 Eskimos living an active life and eating a native and store diet were estimated. Similar estimations were made on a group of 40 Eskimo school children from the Northwest Passage area who were living for three

months in a residential school at Inuvik with restricted outside activities.

SUMMARY AND CONCLUSIONS

The living conditions, sources of food and the diet of the Eskimo of the Northwest Passage area have been described.

The results of hemoglobin, blood smear, urine, brucellosis, PBI, protein and lipid assessments of specimens obtained from 50% of the population are presented.

The rapidly changing social and living conditions and the trend towards adoption of the white man's diet are potential hazards to the health of the Eskimo. Every assistance possible should be given to the Eskimo so that he can obtain good housing and a correct balanced diet in an area where both housing material and store food costs are the highest in Canada.

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PAGES OUT OF THE PAST: FROM THE JOURNAL OF FIFTY YEARS AGO

CASES FROM "THE SHAMBLES"

Before my arrival the medical staff of the hospital was complete, so it has fallen to my lot to work at the railway sheds in Dunkirk, or at the "shambles", as we call them, every night. The following is an example of the conditions we encounter.

Acute insanity. A French soldier was seen on a cot in "sheds", evidently a case of acute insanity, and those of us who saw the poor fellow will never forget him. He was a man apparently about twenty-five to thirty years of age, of pale countenance, and rather drawn appearance. He seemed to be lying quietly on his side, when suddenly he

would start up, look way off into the distance with terror written strongly on his face, and biting the ends of his fingers he would seem to follow the flight of a shell as it gradually came towards him. He would get up on his knees and when his glance reached the roof, right above him, he would utter a sharp cry, shake all over and bury his head in the pillow. This performance was repeated every few minutes. This is the only case of such a kind seen down there, but they say there have been many. It seemed a hopeful sign that we were able to persuade him to eat and drink something. But it was a sad sight and the *brancardiers* turned away exclaiming, "*C'est très triste, très triste.*"—The War, T. A. Malloch, *Canad. Med. Ass. J.*, 5: 158, 1915.